CHAIRMAN OF THE JOINT CHIEFS OF STAFF INSTRUCTION

J-3 CJCSI 3900.01B
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POSITION REFERENCE PROCEDURES

Reference: DODD 5105.60, 11 Oct 1996, "National Imagery and Mapping Agency (U)"

1. Purpose. This instruction establishes policy in the use of position reference procedures for unilateral and joint operations of the US Armed Forces and for multinational operations with the military forces of allied nations.

2. Cancellation. CJCSI 3900.01A, 10 August 1998, "Position Reference Procedures," is canceled.

3. Applicability. This instruction applies to the combatant commands, Services, Defense agencies and Joint Staff.

4. Policy

a. In unilateral operations, the US military force of the commander involved will use the World Geodetic System 1984 (WGS 84) geodetic latitude, longitude and height (Height Above Ellipsoid), unless the commander determines that the use of other position reference systems (horizontal and/or vertical datum) is mission critical. Universal use of the WGS 84 position reference system (datum) will eliminate confusion regarding which system is being used in reporting positions.

b. In all joint operations, users will reference coordinates (horizontal and vertical) to WGS 84. Due to WGS 84's global three-dimensional datum characteristics and because several vertical models are defined within WGS 84, users will report the vertical model referenced in respect to WGS 84 (i.e., Earth Gravity Model (EGM) 96, EGM 84, etc.) whenever a deviation of the policy stated in paragraph 4a becomes necessary. If

some preexisting circumstance precludes using the WGS 84 datum or any of its components (horizontal, vertical or both), combatant commanders will coordinate on the position reference system(s) (horizontal and/or vertical datum) and procedures to be used.

c. Ground forces, navigating and operating off of hard copy maps based upon the Military Grid Reference System (MGRS) and mean sea level (MSL), will continue to be supported in the WGS 84 coordinate system. In lieu of MSL, ground forces will report ellipsoid height when available to support precision targeting and precise location of geographic features or military units.

d. For any operation, several local and/or regional horizontal and vertical datums may exist throughout the area of interest and, under special circumstances, may be used by US military forces in lieu of WGS 84. In coordination with the National Geospatial-Intelligence Agency (NGA), commanders will determine the appropriate local and/or regional horizontal and/or vertical reference system (datum) for use. Furthermore, due to the existence of several vertical datums worldwide from which to derive heights – with each height modeling a different surface (ellipsoid, geoid, and topographic) – extreme care must be exercised when reporting the vertical coordinate of a three-dimensional position. As a result, users will report the height source and vertical datum in accordance with the procedures contained in the Enclosure to this instruction.

e. Two-dimensional (2-D) positional information shall be represented as either geographic coordinates or grid coordinates. When reporting 2-D positional information using geographic coordinates, use the sexagesimal system, expressed or represented in degrees, minutes and decimal minutes (DDMM.mmmm). When reporting 2-D positional information using grid coordinates, and unless otherwise directed by the respective combatant commander, use the Universal Transverse Mercator (UTM) or Universal Polar Stereographic (UPS) grid system, expressed in the grid reference alphanumeric position reporting system, MGRS.

f. The horizontal components of three-dimensional (3-D) positional information shall be represented in accordance with subparagraph 4e above. Express the vertical component as either a positive (+) or (-) to indicate that the position is above or below the vertical datum.

g. All graphical 2-D and 3-D positional data software shall simultaneously display geographic and grid coordinates (in accordance with subparagraphs 4e and 4f above) except where miniaturization of system displays renders this impractical.

5. Definitions. See Glossary.

6. Responsibilities

a. The Director, NGA, will establish specifications and procedures for applying position reference systems to geospatial intelligence. WGS 84 is the official DOD positional reference system. NGA will assist its allied co-producers in using this system. When WGS 84 cannot be used, NGA will assist the combatant commanders in determining an appropriate reference system. NGA will provide standard algorithms and parameters to perform datum transformation and coordinate conversion (i.e., Geographic Translator (GEOTRANS)). For existing products (e.g., maps, software, aircraft systems) not in compliance with this instruction, NGA will coordinate with the affected agency, combatant commander or Service on the feasibility to convert these products with regard to time, cost and scheduling. NGA will coordinate with the Joint Staff, Defense agencies, combatant commands and the Services in making all future products used for position reference in compliance with this instruction.

b. Combatant commanders will develop procedures for coordinating the use of the WGS 84 system of coordinates in all joint operations involving US military forces. Combatant commanders will coordinate with allied commands on position reference procedures to be followed within areas of multi-national interest. In cases where conditions preclude the use of WGS 84, combatant commanders will coordinate on the use of position reference procedures.

7. Summary of Changes

a. Institutes WGS 84 as the DOD geospatial standard reference.

b. Updates reporting procedures to include height coordinates and associated information.

c. Changes references to Mapping Datum Transformation (MADTRAN) software to GEOTRANS software.

d. Establishes NGA as the source of specifications and procedures to transform coordinates between datums and to convert coordinates between coordinate systems.

8. Releasability. This instruction is approved for public release; distribution is unlimited. DOD components (to include the combatant commands), other Federal agencies and the public may obtain copies of this instruction through the Internet from the CJCS Directives Home

Page--http://www.dtic.mil/cjcs_directives. Copies are also available through the Government Printing Office on the Joint Electronic Library CD-ROM.

9. Effective Date. This instruction is effective upon receipt.

For the Chairman of the Joint Chiefs of Staff:

T. J. KEATING
VADM, USN
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Enclosure:
Reporting Process

ENCLOSURE

REPORTING PROCESS

1. When reporting 2-D positional information using a grid coordinate, provide the following information.

a. Type of Grid. Identify the grid reference system of the source (MGRS, UTM, UPS, etc.). Unless otherwise directed by the respective combatant commander, the UTM or UPS grid systems will be the basis and expressed in the grid reference alphanumeric position reporting system, MGRS.

b. Grid Coordinate. Coordinates of a grid coordinate system to which numbers and/or letters are assigned for use in designating a point on a grid map, photograph or chart (32UNA123456 (MGRS), etc.).

c. Feature Description. Narrative characterization of the geospatial feature by the coordinate represented (e.g., the top center of the Washington Monument; the base of the flagpole located on the north side of the Capital Building, etc.).

d. Horizontal Source System. System identifier used to calculate or derive coordinates of the geospatial feature representation (e.g., Joint Services Imagery Processing System (JSIPS), Global Positioning System (GPS), map, Digital Point Positioning Database (DPPDB), etc.).

e. Horizontal Datum. Horizontal or geographic datum identifier that denotes the numerical or geometrical quantity that uniquely serves as a reference for the production of the geospatial point position (e.g., WGS 84, Tokyo, etc.).

f. Example. 38S MB 26490 83145 (MGRS), center of city, using map, WGS 84.

2. When reporting 2-D positional information using a geographic coordinate, provide the following information.

a. Latitude (x) Coordinate. The geographic coordinate identifying the position of a point with the ability to indicate precision to 1/10,000 of an arc minute, north or south of the equator. Example: DDMM.mmmm only (followed by “N” for north of the equator or “S” for south of the equator).

b. Latitude Format. Latitude format identifier denotes the numerical representation of latitude. For example, "DDMM.mmmmH" where DD is degrees, MM is minutes, .mmmm is decimal minutes, and H, proceeding the decimal minutes, is "N" north of the equator or "S" south of the equator. The coordinate shall be expressed as DDMM.mmmm"N" or DDMM.mmmm"S".

c. Longitude (y) Coordinate. The geographic coordinate identifying the position of a point with the ability to indicate precision to 1/10,000 of an arc minute, 0 to 180 degrees east or west of the prime meridian. Example: DDDMM.mmmm only (followed by "E" for east of the zero meridian or "W" for west of the zero meridian).

d. Longitude Format. Longitude format identifier denotes the numerical representation of longitude. For example, "DDDMM.mmmmH" where DDD is degrees, MM is minutes, .mmmm is decimal minutes, and H, proceeding the decimal minutes, is "E" east of Greenwich or "W" west of Greenwich. The coordinate shall be expressed as DDDMM.mmmm"E" or DDDMM.mmmm"W".

e. Feature Description. See subparagraph 1c above.

f. Horizontal Source System. See subparagraph 1d above.

g. Horizontal Datum. See subparagraph 1e above.

h. Example. 03317.0921N 04412.6332E, center of city, using GPS, WGS 84.

3. When reporting 3-D positional information using a grid coordinate, provide the following information.

a. Type of Grid. See subparagraph 1a above.

b. Grid Coordinate. See subparagraph 1b above.

c. Vertical Coordinate. Vertical distance of a point above or below a reference datum. Points may be plus (+) or minus (-) according to whether the point is above or below the vertical datum (e.g., 1234.56, 12.34, etc.).

d. Height Units. Linear unit of measure in which height information is reported. Examples: meters, feet, etc.

e. Feature Description. See subparagraph 1c above.

f. Horizontal Source System. See subparagraph 1d above.

g. Vertical Source System. The system identifier used to calculate or derive the height of the geospatial feature representation (JSIPS, GPS, map, DPPDB, survey data, etc.).

h. Horizontal Datum. See subparagraph 1e above.

i. Vertical Datum. Any level surface (as, for example, mean sea level) taken as a surface of reference from which to determine heights. Examples: WGS 84 Ellipsoid, North American Vertical Datum of 1988 (NAVD 88), Tokyo Bay Mean Sea Level, WGS 84 EGM96, WGS 84 EGM84, etc.

j. Example. 38S MB 26490 83145 (MGRS) +135.23, center of city, using map, WGS 84 EGM96.

4. When reporting 3-D positional information using a geographic coordinate, the following information will be provided.

a. Latitude (x) Coordinate. See subparagraph 2a above.

b. Latitude Format. See subparagraph 2b above.

c. Longitude (y) Coordinate. See subparagraph 2c above.

d. Longitude Format. See subparagraph 2d above.

e. Vertical Coordinate. See subparagraph 3c above.

f. Height Units. See subparagraph 3d above.

g. Feature Description. See subparagraph 1c above.

h. Horizontal Source System. See subparagraph 1d above.

i. Vertical Source System. See subparagraph 3g above.

j. Horizontal Datum. See subparagraph 1e above.

k. Vertical Datum. See subparagraph 3i above.

l. Example. 03317.0921N 04412.6332E +135.23, center of city, using GPS, WGS 84 Ellipsoid.

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GLOSSARY

PART I--ACRONYMS

2-D	two-dimensional
3-D	three-dimensional
CJCSI	Chairman of the Joint Chiefs of Staff Instruction
DOD	Department of Defense
DPPDB	Digital Point Positioning Database
EGM	Earth Gravity Model
GEOTRANS	Geographic Translator
GPS	Global Positioning System
JSIPS	Joint Services Imagery Processing System
MGRS	Military Grid Reference System
MSL	mean sea level
NATO	North Atlantic Treaty Organization
NGA	National Geospatial-Intelligence Agency
UPS	Universal Polar Stereographic
UTM	Universal Transverse Mercator
WGS	World Geodetic System

PART II—TERMS AND DEFINITIONS

datum transformation and coordinate conversion - NGA has produced the Geographic Translator (GEOTRANS) software to provide standard transformations between WGS 84 and the major local datums. The Joint Interoperability Test Center has certified GEOTRANS.

ellipsoid - A mathematical figure generated by the revolution of an ellipse about one of its axes. The ellipsoid that approximates the geoid is an ellipse rotated about its minor axis. An ellipsoid serves as the mathematical model from which maps and charts are produced. However, numerous ellipsoids have been developed to support local datums. The use of the WGS 84 ellipsoid provides a single standard of reference within the Department of Defense.

geodetic datum - A reference surface consisting of the following parameters: the latitude and longitude of an initial point (origin), the orientation of the network and the two parameters of a reference ellipsoid. Coordinates for a particular ground location will vary based on the datum used to produce a particular map or chart. Therefore, it is essential that the datum used to derive the coordinates be included when reporting positions. WGS 84 now provides the single standard reference datum, or geographic reference system, within the Department of Defense.

geoid - The equipotential surface in the gravity field of the Earth that coincides with the undisturbed mean sea level extended continuously through the continents. The direction of gravity is perpendicular to the geoid at every point. The geoid is the reference surface for geodetic leveling (surveying) and some inertial navigation systems.

grid - Two sets of parallel lines intersecting at right angles and forming squares. A grid is superimposed on maps, charts and other similar representations of the Earth's surface in an accurate and consistent manner to permit identification of ground locations with respect to other locations and the computation of direction and distance to other points.

height above ellipsoid – The distance above or below the ellipsoid (plus or minus). Ellipsoid height is also called geodetic height.

map projection - An orderly system of lines on a plane surface representing a corresponding system of parallels of latitude and meridians of longitude of the Earth or a section of the Earth.

military grid reference system - Normally created by superimposing a metric, square grid on a UTM or UPS projection. The grid is printed on military maps and certain air and naval charts that include land areas. This position reference system provides a common system for the positioning of points on land or coastal areas and for the rapid computation of direction and distances between points. Also called MGRS.

other geographic, square military grid reference systems - There are other geographic, square military grid reference systems similar to the military grid reference system. These systems are in some areas that have not been converted to the UTM grid.

reference systems (general) - Any method of position referencing and reporting (coordinate system) is dependent upon the ellipsoid and datum used to model the Earth. Any distortions or inaccuracies in the sources of the coordinates, whether from topographic map, aeronautical or hydrographic chart, digital data product or other source can be compounded if different coordinates based on different datums are mixed when reporting positional information. For this reason, it is important to state the reference datum when using any of the grid or geographic systems defined above. To avoid confusion, the procedures established in the Enclosure of this instruction will be followed when passing or transmitting coordinates.

reference systems (other) - Some reference systems involve the use of a grid or use polar coordinates expressed in bearing (azimuth) and distance. The grid or polar coordinates may be permanently superimposed on maps or charts, or they may be temporarily established in relation to some fixed or moving point.

survey data – any measurement (horizontal and vertical) that has been collected for determining the relative positions of points on, above or beneath the Earth’s surface.

vertical datum - A surface that approximates the size and shape of all or part of the Earth’s surface and is designated a height of zero. The height of any point that does not lie on this surface is measured along a line perpendicular to the reference surface and passing through the point.

World Geodetic System 1984 - An earth-centered, earth-fixed worldwide geodetic datum and reference system based on a determination of the Earth's parameters and gravity field. NGA developed the

system as the standard geographic reference system for use within the Department of Defense. NGA uses World Geodetic System 84 in its production of maps and charts. NATO and the allied nations have approved, in principle, the use of the World Geodetic System 1984 for geospatial information purposes. It provides uniform datum and reference system information for use in joint and multinational operations. In addition GPS, which is a navigation tool for air, land, sea and space operations within the Department of Defense, is designed to work in World Geodetic System 84. Also called WGS 84.

World Geographic Reference System - A worldwide position reference system that may be applied to any map or chart graduated in latitude and longitude, regardless of projection. This method expresses latitude and longitude in a form suitable for rapid reporting and plotting. Also called GEOREF System.